

Association Between Wearable Sensor Data and Clinical Scores in Individuals with Early-stage Multiple System Atrophy

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INTRODUCTION

- ❖ Multiple system atrophy (MSA) is a progressive neurodegenerative disorder characterized by a combination of parkinsonism, autonomic dysfunction, cerebellar symptoms, and pyramidal signs¹.
- ❖ MSA features α -synuclein aggregates within neurons and oligodendrocytes in addition to degeneration of striatonigral and olivopontocerebellar systems²⁻³.
- ❖ The wide array of implicated brain regions and symptoms highlights the heterogeneity of MSA, in addition to the challenges associated with timely and definitive diagnosis.
- ❖ Conventional clinical measurements of symptomatology, severity, and progression of MSA lack continuous data and consequentially have a restricted temporal application.
- ❖ Recent advancements in digital at-home monitoring instruments have begun to overcome the disadvantages of more traditional clinic-based measurements.

METHODS

- ❖ Participants (n = 18) in the bioMUSE Natural History Study with clinically probable MSA wore sensors for continuous monitoring of physical activity over 12 months.
- ❖ We determined the association between gold-standard clinical measures and sensor-derived parameters of locomotion, posture, and postural transitions at baseline
- ❖ We developed machine learning models to investigate whether sensor-derived measures could predict scores and performance on clinical evaluations.

RESULTS

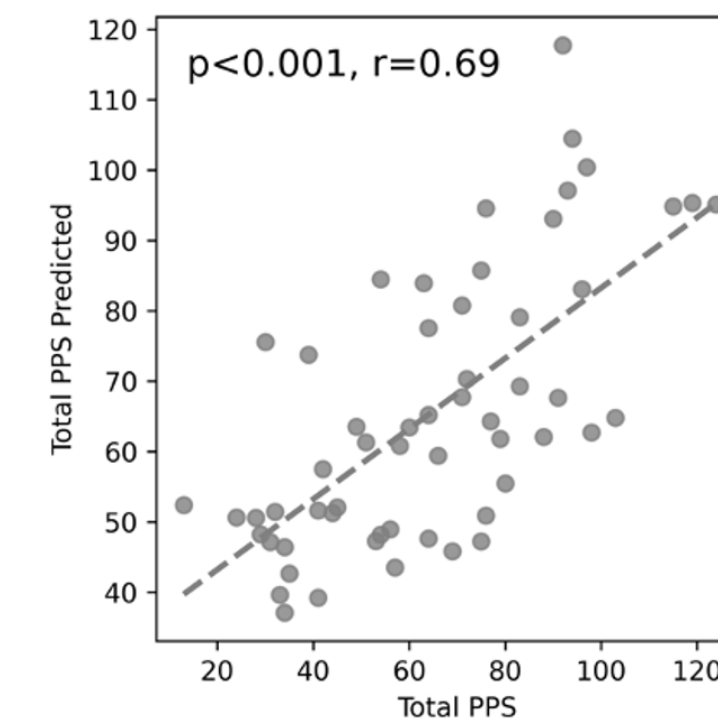
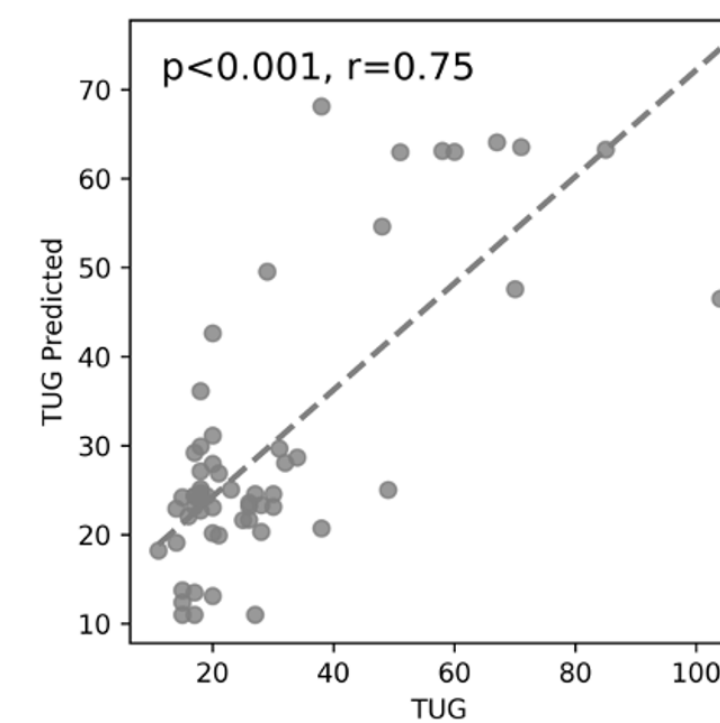
- ❖ Total walking time was negatively correlated with tandem walk ($\rho=-0.705$) and Timed Up and Go (TUG) ($\rho=-0.811$)
- ❖ Total sedentary time was positively correlated with tandem walk ($\rho=0.626$) and TUG ($\rho=0.597$)
- ❖ There was a negative association between daily step count and walking episodes with tandem walk and TUG.
- ❖ Additionally, we identified positive relationships between average sit-to-stand and stand-to-sit durations with UMSARS-II ($\rho=0.722, 0.628$), the motor section of NNIPPS-PPS ($\rho=0.690, 0.689$), and TUG ($\rho=0.644, 0.596$).
- ❖ Regression models established successful prediction of clinical scores, with TUG demonstrating the highest explained variance.

Demographic and Clinical Evaluation

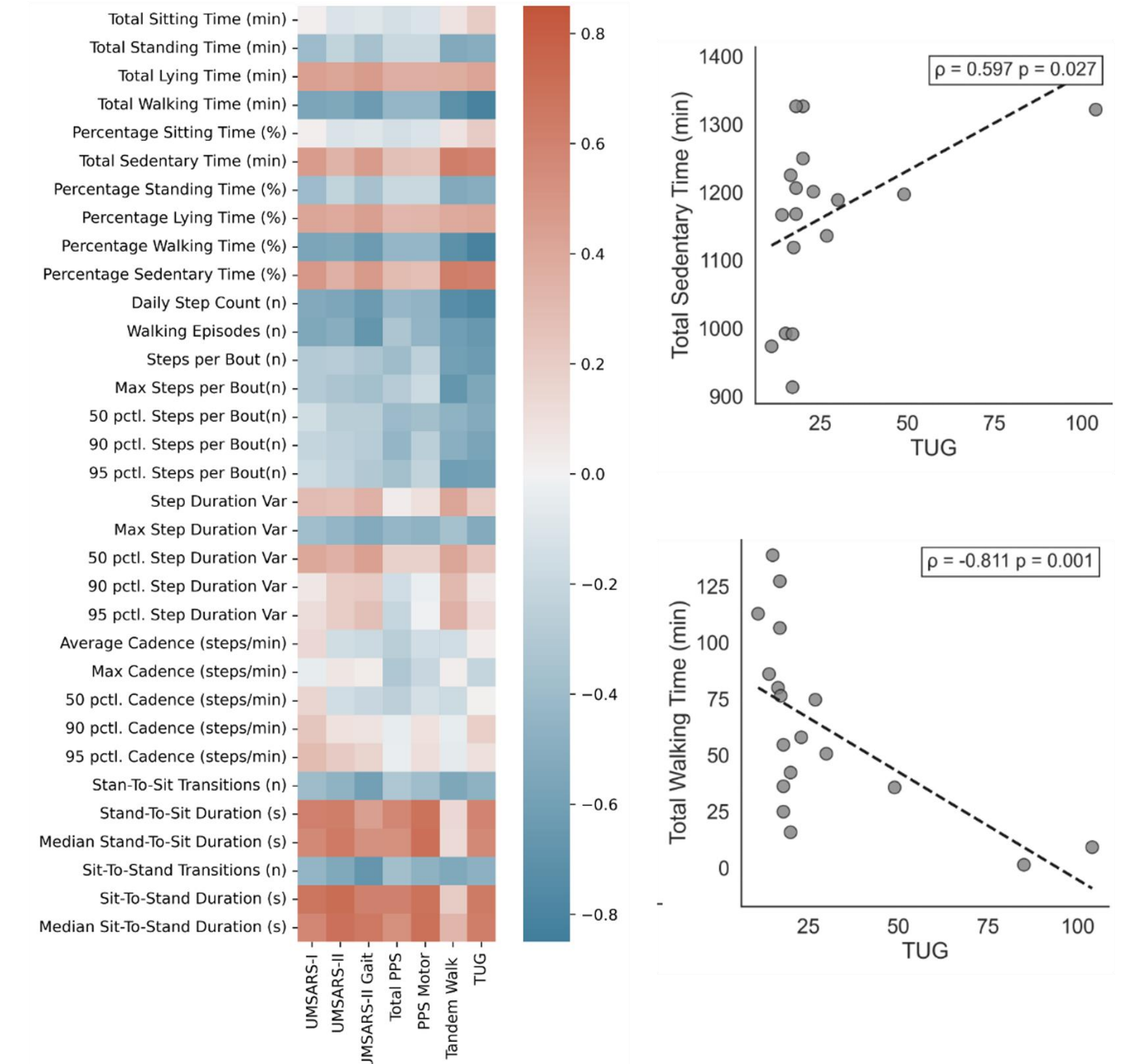
	All Patients (N=18)
Demographics	
Age (years)	62.9 ± 9.2
Sex (M/F)	10/8
Ethnicity (% Caucasian)	94%
Race (% Not Hispanic or Latino)	100%
Handedness (R/L)	13/0
Clinical Characteristics	
UMSARS-I	16.5 ± 5.7
UMSARS-II	14.1 ± 5.8
NNIPPS-PPS	55.2 ± 21.3
Tandem Walk	2.3 ± 0.9
TUG	29.7 ± 26

Model Performance

	MSE	MAE	Explained Variance
UMSARS-I	27.05	4.27	0.35
UMSARS-II	21.35	3.74	0.46
UMSARS-II Gait	4.54	1.73	0.53
NNIPPS-PPS	379.43	15.99	0.47
Tandem Walk	0.78	0.71	0.38
TUG	163.78	8.97	0.55



Sensor and clinical assessment correlations



CONCLUSIONS

- ❖ Sensor-derived metrics, specifically those measuring walking and postural transitions, may increase our understanding of impairments associated with MSA.
- ❖ Our results contribute meaningfulness to digital outcomes in MSA, underlining potential benefits sensors could hold for these patients.

References

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